OIL AND GAS DRILLING WASTE MANAGEMENT CONSIDERATIONS

BY PUBLIC LANDS DIVISION STAFF

DEPARTMENT OF FORESTRY,

LANDS AND WILDLIFE

IN ALBERTA

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A B S T R A C T

In 1975, the Energy Resources Conservation Board, The Department of Environment, the Department of Energy and Natural Resources and industry developed drilling fluid disposal guidelines to provide some control over fluid disposal operations. Public Lands Division assumed management control of these guidelines in September 1983. Because the drilling wastes are toxic and because not much is known about how to properly dispose of the fluids and solids, several steps were taken to help resolve the complex drilling waste disposal problem. Sump contents were analysed using standard soil analysis procedures. Some major detrimental components evidenced were high sodium, high chlorides, high pH and high potassium. Common soil parameters were then noted to help discern disposal options. Burial and deep trenching are being discouraged on open rangeland or agricultural soils. Proper berming of wellsites is being stressed. Surface disposal through on or off lease disposal of treated fluids (where required) and land spreading the solid portion is now encouraged where land is suitable. A consultant was hired to provide an interim disposal manual for use by government field staff. Ongoing site evaluations and field trials should help lead to more suitable and environmentally acceptable drilling waste disposal practices on public lands in Alberta.

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* Paper presented at the 11th Annual Canadian Land Reclamation Conference, Vancouver, British Columbia, June 3-6, 1986.

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INTRODUCTION

Since oil and gas exploration began in Alberta, over 100 000 wells have been drilled. The wells range in depth from several hundred feet to over 20 000 feet. The larger oil discoveries such as Turner Valley and Leduc have resulted in closer well spacing with often a well for every quarter section. The foothills and mountain regions have the deeper wells and the southeast plains regions have the shallower wells. More recently, heavy oil development in the Lloydminster, Cold Lake and Peace River regions have caused such concentrated well spacing that pad systems from five to 20 wells per two to four acre-sized pads are being drilled. The numerous wells drilled in the past and the many wells to be drilled in the future plus the increasing complexity of drilling waste components have all heightened the concern about how to safely dispose of all drilling wastes produced.

A) DRILLING WASTES

For purposes of this discussion drilling wastes are those components that remain in a drilling waste sump pit after a well has been drilled. The wastes are composed of many varied substances and no two pits are likely to contain the same constituents.

The wastes generally comprise the following components:

- Bentonite (sodium montmorillonite)
- water
- salt
- crude oil
- other additives such as:
    - sodium acid pyrophosphate
    - bicarb of soda
    - aluminium silicate
    - carboxymethyl cellulose
    - guar gum
    - $CaSO_4$
    - starch
- cuttings from the hole

A major problem that can occur with drilling waste sumps is that the rig crews can view the sump as a garbage pit and dump in the following:

- scrap iron, drums, cans
- drilling mud sacks
- casing protectors
- engine oil
- rig detergent or rig wash

Because sumps contain a complex mixture of liquids, solids, organic and inorganic compounds, the components may remain inert, or more likely interact synergistically or antagonistically (Shaw 1986, personal communication). Such degree of unknown reaction and component complexity

makes treatment difficult and potential detrimental environmental impact very probable.

The 1985 ERCB (Energy Resources Conservation Board) Interim Report No. 1 titled "Determination of Toxicity of Sump Fluids" illustrates the concern relating to sump fluid toxicity. In 1983-84, 10 929 wells were spudded. Sump fluids were tested for 574 of these wells and 344, or 60%, of the wells were found to be toxic. The toxicity parameter used was the 96 hour Trout Test or the Microtox Test which uses bacterial flourescence.

B) REGULATORY CONSIDERATIONS

The Public Lands Division is one of two divisions in the Department of Forestry in the Province of Alberta responsible for managing all the Crown-owned lands. Public Lands Division manages those lands found within the non-forested, more settled areas of the province. The Alberta Forest Service, the other division, manages all Crown land within the forested area of the province. Generally, outside of water and air, these two divisions are responsible for safeguarding the land surface against environmental damage. These two divisions are responsible for enforcing the regulations pertaining to sump waste disposal on Crown lands.

1) Interim Directive ID-OG 75-2

Exploratory drilling, production and most wellsite activities are regulated by a government-designated body, the ERCB. The board is also responsible for controlling pollution and ensuring environmental conservation

in the exploration for, processing, development and transportation of the energy resources. In the early 1970s the ERCB realized that disposal standards were necessary to deal with toxic drilling wastes. Working with industry and the two main government departments, Alberta Forestry (now Department of Forestry, Lands and Wildlife) and Alberta Environment, in 1975 the ERCB developed interim guidelines called Interim Directive ID-OG 75-2 (75-2). These guidelines were issued in August 1975 (Appendix 1) and pertained to the surface disposal of drilling fluids (not the solids component). Public Lands Division assumed management control of the sump fluid guidelines in September, 1983.

The 75-2 guidelines have two features worth highlighting. The first concerns on-lease sump fluid disposal. Here the fluids must be contained to the lease, with the main criteria being that the fluids must usually be less than 6 000 barrels in volume. The lease must be 100 m from the normal high water mark of a water body. The second feature, off-lease sump fluid disposal, is acceptable when the following criteria are met:

a) Chloride content: 1 000 mg/l maximum

b) Sulfate content: 2 000 mg/l maximum

c) Total Dissolved Solids: 4 000 mg/l maximum

d) pH must be between 5.5 to 8.5

e) Trout survival test: three trout fingerlings (four to 10 cm) must survive 96 hours in the treated fluid

2) Subsurface Disposal

In 1981, the ERCB brought out a directive concerning the subsurface disposal of drilling fluids (Appendix II). Fluids may be disposed to unsuccessful drilled holes or to any well designated by the ERCB. The disposal zone must be at a depth greater than 600 m to protect potable water sources. Formation water in the disposal zone must not have a total dissolved solids content of less than 20 000 ppm, again to protect potable water sources.

3) KCl Disposal

In 1982, the Department of Energy and Natural Resources issued an Information Letter requesting that any company utilizing KCl drilling muds on Crown lands must submit a disposal plan which requires department approval before lease construction (Appendix III). The letter was issued because of KCl toxicity problems which could harm plant and animal life.

4) Acre Spread Rate

Because of the toxicity that sodium and potassium pose to animal life and the ion and salt effects on vegetation, a control measure to handle salt muds was proposed by the chief chemist, Mr. D. Shaw, of the ERCB. Using barley and conifer seedlings grown in trays containing a soil mix with a starting conductivity of 0.6 ds/m, Mr. Shaw washed the seedlings in several NaCl baths at different concentrations to determine salt tolerance.

Eventually Mr. Shaw determined a figure of 450 kg of chloride that could be safely spread on an hectare of soil without damaging a seedling. Thus Mr. Shaw determined a calculation to estimate the number of acres required to spread chloride salts based on:

- chloride ion concentration in ppm
- a barrel of fluid (159.11 L) weighing 145.45 kg
- the number of barrels for disposal
- a spread rate of 450 kg Cl^- ion/ha

The equation is thus:

$$\text{Acres required} = \frac{[Cl^-] \text{ ppm} \times 159.0 \text{ kg/bbl} \times \text{no. of bbls}}{450 \text{ kg } Cl^-/\text{ha} \times 10^6 \text{ (to cancel ppm)}}$$

Thus one could spread 1 000 barrels at a 3 000 ppm over one hectare. The above spread rate can probably be adjusted higher on lighter textured soils depending on sodicity of the muds and receiving soils, and if calcium amendments are used.

C) INHERENT TOXIC PROBLEMS

At least two main inherent considerations with drilling wastes that impute toxicity problems must be considered in disposal situations. The first is the chemical makeup of the waste. The second aspect is the physical makeup of the actual sump material.

1) Chemical Considerations

Chemically, drilling wastes pose four major environmental concerns. The first, and not necessarily most hazardous concern, is the inorganic or salt components. In Alberta, with the larger heavy oil developments occurring in Lloydminster, Cold Lake and the Peace River regions, large quantities of drilling wastes are going to be produced over the next several decades. Most of the drilling wastes will be salt based with the salts being predominantly sodium and potassium chlorides. Smaller amounts of potassium sulphate, magnesium chloride and sodium sulphate will also be present in these mud and fluid components. Several million kilograms of salt will be produced in these muds by the time drilling activities start to decline. The major concern is how the salts will affect soils, vegetation and groundwater. About 220 000 ha of arable land are being salinized each year in Western Canada (P.F.R.A. 1983). Though some of the salinization is due to agricultural practices, the concern remains that any additional salt buildup at the land surface is not favorable and should be avoided where possible.

The second chemical concern is the problem of increased concentrations of sump contents. Because the 75-2 guidelines state that sumps under 6 000 barrels may be spread on the lease, if the contents can be contained to the lease area, industry has made an effort to reduce the fluid content of the sumps. However, the reduced liquid component only increases concentrations of salt and organics because what could have been an 8 000 to 10 000 barrel sump often ends up being a sump smaller than 6 000 barrels but with higher component concentrations.

The third concern involves a centralized sump that accepts drilling fluids from many wells, thus ending with only one treatment site. However, the effect of dumping many different sump fluids into a central pit increases the chances of an untreatable sump.

The fourth chemical concern pertains to the organic additives found in the muds/fluids. These organics vary greatly in amount and toxicity. Diesel fuels, starches, xanthum gums, sodium carboxymethyl cellulose, polyacrylates and oxide polymers are just a few of the organics used. Individually these substances are somewhat predictable as to their toxicity and also their ability to break down, if they are left to decay in a biologically active soil or left to degrade by photo-chemical oxidation. It would appear that certain additives are not readily degradable under either aerobic or anaerobic conditions, (polyacrylamides, lignosulfonates, xantham gums and asphalts). However, some "natural" compounds such as celluloses, starches, alcohols and diesel fuels are degradable, especially under aerobic conditions (Hutzinger and Veerkamp 1981). When these organics are used in concert, their combined toxicity could become untreatable, a situation that has been experienced in Alberta. The additional complication of insitu alteration of these additives down hole has not been examined, nor has the effect of combinations of organic additives and inorganic mud components. For example, what is the effect of the addition of sorptive clays on biodegradation of organic additives? What levels of salt are inhibitory to degradation of specific additives?

2) Physical Considerations

The second consideration that affects overall toxicity has to do with physical stratification of the sump contents. Sump contents are almost always found in at least three layers. In Alberta we have seen ample evidence of this feature. In Table 1, a stratified chloride calcium and pH reading is shown. It is also likely that the organics are stratified in such a manner. After normal settling, a buildup of solids and organic materials may often occur at the bottom portion of the pit.

Table 1 *

SELECTED ANALYSES OR SAMPLES ACCORDING TO DEPTH SHOWING STRATIFICATION

Sample Elevation	Ca ppm	Cl ppm	ph
surface	300	1650	7.1
3 ft.	350	2620	7.4
6 ft.	490	6900	9.2
8 ft.	560	7000	9.3
10 ft.	1520	7990	9.7

* G.A. Specken. 1975. Treatment and Disposal of Waste Fluids From Onshore Drilling Sites. A paper presented at the May 21-25, 1975 U.S. Environmental Protection Agency - A.P.I. Conference on Environmental Aspects of Chemical Use in Well Drilling Operations, Houston, Texas. U.S.A.

A second concern, related to physical segregation of the drilling wastes, possibly occurs after the fluid components have been clarified or the sump has been what is traditionally known as "detoxified". ;Detoxification can occur when the solids are precipitated using alum and when the waters are treated with activated carbon. Such treatment further concentrates many undesirable components at the solids layer towards the bottom of the pit. As the solids portion of drilling wastes have never been under regulatory control and as it does not usually receive proper chemical treatment, a concern arises about how this waste component should be disposed.

D) WASTE DISPOSAL OPTIONS IN ALBERTA

The Crown lands in Alberta are managed by two divisions which have differing end land uses. The Alberta Forest Service desires to maintain a timber base and therefore tree clearing is minimized in the forested areas. The Public Lands Division manages the open range and agriculturally oriented Crown lands and is therefore not necessarily concerned about tree removal. Any tree clearing enhances agricultural capability. Therefore, drilling waste disposal methods will differ between the forested and the nonforested Crown lands.

Drilling waste disposal is handled by four basic methods or variations of these methods as directed by the two land-managing divisions. They are:

1) in pit burial
2) deep trenching or modified deep trenching and shallow trenching

3) standard squeezing

4) surface spreading

A fifth option, that of full chemical and physical treatment of sumps, is being tested in Alberta. The first two methods listed above were practised more commonly in the forested areas because of restricted working space. The second and third methods listed have been practiced most commonly on the open range. The first two methods are now being discouraged. The buried components tend to remain untreated in place and pose a potential contamination threat to groundwater, contamination either by the salts or the organics. The standard squeezing technique whereby a cat slowly pushes the sump fluids out one end of the pit by pushing in fill material at the other end, is still acceptable. However, a portion of the solids still tends to remain behind in the pit. Therefore, removing the contents entirely by a backhoe and spreading them on the land surface is becoming the preferred method of drilling waste disposal.

Alberta has not decided on the best method of applying solid sump wastes to the soil surface. Up to the present, the Public Lands Division, where applicable or suitable, has suggested that drilling waste solids straight (i.e. bentonite gel muds) be spread onto the soil surface at a five to 10 cm depth. The amount would vary depending on the degree of toxicity. Spread rates for salt mud solids are still being requested at a rate of 450 kg of choride/ha. The figure could be increased, depending on the site situation and the volume and concentration of mud. Public Lands Division has also recommended that 0.5 to 1.5/kg of gypsum per barrel of "land applied" waste be mixed into the drilling waste pit or the mud/soil component. Each

site is treated individually; there is no standard approach. However, the Department of Forestry is beginning to ask that both the drilling waste and the receiving soil be analysed for electrical conductivity, pH, texture, sodium absorption ratio, cations and nutrient status. From these two analyses, amendments may be recommended.

E) LAND APPLICATION CONSIDERATIONS

Surface land application of drilling wastes must be environmentally and economically feasible. As can be seen in Table 2 and Table 3, a recent analysis of a KCl drilling waste, and another KCl, NaCl and fresh water drilling waste, shows that the two most crucial problems are electrical conductivity and the high sodium ion concentration. Given a suitable receiving soil and an adequate spread area, detrimental salinity and sodicity (when first washed if necessary and then augmented by a calcium amendment if needed) effects can be greatly minimized. Further, under favorable environmental conditions, the bacteria and fungi at the soil surface are capable of degrading a wide variety of organic compounds. Ultraviolet light can cause photochemical changes; in particular, photoxidation of hydrocarbons and aromatic compounds, possibly rendering the resulting molecules to be more susceptable to microbial attack (Edwards 1983). With increasing depth in the soil profile, the absolute number of microbes decreases, generally leading to lower degradative capability. Therefore, drilling waste burial is not advisable.

Before surface spreading a drilling waste, several considerations are required. Firstly, the receiving environment must be suitable. Sandier

Table 2 *

PRODUCTIVITY RATINGS FOR A KCl DRILLING MUD WASTE AS A SOILS COMPONENT

Property	Value	Rating
Reaction (pH)	7.5	Good
Salinity (dS/m)	51	Unsuitable
Sodicity (SAR)	67	Unsuitable
Saturation (%)	62	Fair
Texture	L	Good
$CaCO_3$ Equivalent (%)	12	Fair
Toxic Components	To be evaluated	

* Dr. C. Palmer, 1985. Drilling Wastes as a Soils Component. A paper presented at the April 23-24, 1985 Drilling Wastes Reclamation Review Technical Advisory Committee Workshop, Edmonton, Alberta.

Table 3

DRILLING WASTE SOIL ANALYSIS

Hole No.	Saturation %	pH Paste	E.C. dS/m	SAR	Ca me/L	Mg me/L
1	55	8.10	6.14	6.63	27.20	16.00
2	100	12.44	11.84	299.60	0.05	0.05
3	62	8.40	197.30	676.60	65.00	5.95

Hole No.	Na me/L	K me/L	NH_4^-N me/L	NO_3^-N me/L	Cl me/L	SO_4 me/L	CO me/L	HCO_3 me/L
1	30.8	1.48	.085	.025	18.750	53.0	-	2.00
2	67.0	0.81	.320	.050	9.500	10.4	3.03	29.32
3	4030.0	9.60	.170	.105	3550.000	140.0	-	1.12

1 = fresh water gel mud sump

2 = KCl polymer gel mud sump

3 = NaCl saturated gel mud sump

sites are likely to benefit best from the waste. Sodic soils are poor receivers as well as areas that have high water tables, that are close to surface waters or that have shallow bedrock. Forested areas and mountainous areas have a limited land base for spread potential. High quality agricultural soils may not be acceptable for a waste spread.

A second component concerns the application method. Several possibilities exist that have not been adequately tested.

Such possibilities are:

a) Use of backhoe to extract waste from a pit and then use of a bulldozer to spread the waste
b) Use of backhoe and a manure spreader
c) Use of a sewage sludge spreader where waste is spread as a water slurry
d) Use of a bulldozer alone
e) Use of a vacuum pump and a bulldozer

Such site selection and application method concerns need to be more carefully examined.

F) ON-GOING WORK

The amount of literature concerning drilling wastes and the environment has been accumulating for at least 10 years. Within the past two years the waste material has received prominent consideration in Oklahoma, Saskatchewan and, now, Alberta. Because there is not a comprehensive review

to date that deals with the material and its effects on the environment, Alberta Environment, under the guidance of the Reclamation Review Technical Advisory Committee (RRTAC), commissioned a consultant to compile a major report on drilling wastes. The consultant was directed to review drilling wastes and their potential effect on the environment and to prepare a field manual to help government field staff decide how best to dispose of drilling wastes in any given general location. From this report and on-going field work, further research will likely occur concerning drilling waste disposal.

CONCLUSION

Given the complexity of inorganic and organic chemicals used in North America, all possible treatment and disposal options should be carefully reviewed for drilling wastes. Despite the existing regulations for on and off lease drilling fluid disposal and down hole fluid disposal, the most effective means for mitigating environmental problems caused by drilling waste solids disposal is yet be developed.

Disposal options will vary according to geographical location and site conditions. Full chemical treatment and dewatering systems should be considered for areas within forested regions where land spreading is restricted because of a desire to maintain a timber base. Land application of drilling wastes could occur on open agricultural areas where soil textures are suitable, the terrain is relatively flat to allow machine work and prevent runoff, and water tables are not near the soil surface. Drilling waste burial of any form should rarely occur unless absolutely necessary and only if the muds are well removed from urban areas, farm areas, watercourses,

high water tables, and all but tight clay land fill sites. In this latter case, the muds should be detoxified of both salts and organics before burial. As long as the economics of waste disposal are not excessively prohibitive, the most environmentally safe disposal method should always be used.

REFERENCES

Edwards, N.T. 1983. Polycyclic Aromatic Hydrocarbons (PAH's). In: The Terrestrial Environment - A review. J. Environ. Qual. Vol. 12; 427-441.

ERCB. Personal Communication. G. Berndtsson, P.Eng. Assistant Manager, Drilling and Production, Development Department, Energy Resources Conservation Board, 640 - 5th Avenue, S.W., Calgary, Alberta, Canada, T2P 3G4.

ERCB. Personal Communication. D.R. Shaw, Chief Chemist, Energy Resources Conservation Board, 640 - 5th Avenue, S.W., Calgary, Alberta, T2V 3G4.

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APPENDIX I

TO INTERIM DIRECTIVE NO. ID-OG 75-2

SUMP FLUID DISPOSAL REQUIREMENTS

1.0 Disposal of Sump Fluids to a Subsurface Formation

Disposal of sump fluids to a subsurface formation is an acceptable procedure provided:

a. Approval is first obtained from the Energy Resources Conservation Board.

b. The subsurface formation is not locally productive of oil or gas.

c. The formation water in the disposal zone has a total dissolved solids content greater than 20,000 mg/l.

2.0 Disposal of Sump Fluids on the Lease

Disposal of sump fluids to the lease is an acceptable procedure providing all of the following conditions are met:

a. Notice of at least one week has been given to:

i. the appropriate District Office of Alberta Energy and Natural Resources if the well was drilled on any public land in the province.

ii. the appropriate Area Office of the Energy Resources Conservation Board if the well was drilled on any other lands not specified in section 2.0 (a).

b. The entire contents of the sump are confined to the lease.

c. The sump(s) contain less than a total of 6,000 barrels of fluid. Not withstanding this limitation, approval may be given by the Board or Alberta Energy and Natural Resources to dispose of more than 6,000 barrels of fluid to the lease providing it can be shown that the entire contents of the sump will be confined to the site. Applications for such approval shall be directed, in the appropriate way, to either the Area Office of the Energy Resources Conservation Board or District Office of Alberta Energy and Natural Resources.

d. The lease is more than 300 feet from the normal high water mark of a body of water, permanent stream or potable water well.

e. The lease site will, in the opinion of the Energy Resources Conservation Board or Alberta Energy and Natural Resources, accept the sump contents to be disposed, without run-off.

3.0 Disposal of Sump Fluids off the Lease

3.1 Disposal of sump fluids to off-lease land areas is an acceptable procedure providing:

a. The sump fluids meet the following criteria:

Chloride Content	1000 mg/l Maximum
Sulfate Content	2000 mg/l Maximum
Total Dissolved Solids	4000 mg/l Maximum
pH	5.5 to 8.5
Trout Survival Test	96 Hrs. (see Appendix B - Guidelines Used to Determine Fish Toxicity Tests on Sump Fluids).

b. Approval to dispose off the lease has been obtained in accordance with section 3.3.

3.2 The Energy Resources Conservation Board or Alberta Energy and Natural Resources will consider off-lease disposal which is not according to the criteria outlined in section 3.1. Application shall be made, in the appropriate case, to the Area Office of the Energy Resources Conservation Board or the District Office of Alberta Energy and Natural Resources.

3.3 Off-Lease Disposal Approval

3.31 On public lands throughout the Province, disposal of well sump fluids to land off the lease and the location of the disposal site must be approved by the appropriate District Office of Alberta Energy and Natural Resources.

3.32 On all land not described under subsection 3.31, disposal of well sump fluids to land off the lease must be approved by the Energy Resources Conservation Board, subject to the disposal and disposal site having been approved by the landowner.

3.33 Any licensee of a well who intends to dispose of fluids to land off the lease area shall:

a. sample the fluids according to the procedure outlined in Appendix A.

b. analyze and field-treat the sump fluids so that the fluid to be disposed of meets the criteria outlined in section 3.1. Tests must conform to the guidelines outlined in Appendix B.

c. two days prior to treating the fluids and depending on whether the lease is located on public or other lands, notify, in the appropriate case, the District Office of Alberta Energy and Natural Resources or the Area Office of the Energy Resources Conservation Board.

3.34 The request for approval to dispose of sump fluids to land off the lease area must be submitted, in the appropriate case, to the District Office of Alberta Energy and Natural Resources or the Area Office of the Energy Resources Conservation Board, and contain the following information:

a. a description of the sampling procedure.

b. a general description of the method of treatment of the sump fluids.

c. an analysis of a representative sample of the treated sump fluids (including trout survival test).

d. the location of the disposal area and the volume of sump fluids to be disposed of.

e. a brief description of the surrounding area (i.e., whether it is forested, muskeg, swamp and the kind of vegetation present).

f. in the case of disposal to private lands, a statement that the landowner's permission has been obtained to dispose to the off-lease site.

3.4 Disposal of well sump fluids to any surface water either directly or indirectly by land surface drainage must be approved by Alberta Environment. Only under rare circumstances, and where sufficient lease land or peripheral land disposal sites are not available, is such disposal considered.

APPENDIX II

INTERIM DIRECTIVE ID 81-1

ENERGY RESOURCES CONSERVATION BOARD
Calgary, Alberta

TO: ALL OIL AND GAS OPERATORS

SUBSURFACE DISPOSAL OF DRILLING FLUIDS

This Interim Directive supersedes Interim Directive ID 70-3 issued on 15 December 1970.

The Board will permit operators to dispose of drilling fluids not only in dry holes but to any well where subsurface disposal of drilling fluids is feasible.

The Board believes that under appropriate constraints the subsurface disposal of drilling fluids can be carried out without jeopardizing any subsurface potable water horizons. It will consider such disposal as part of the drilling or completion program for a well and separate approval under section 38 of The Oil and Gas Conservation Act will not be required. The subsurface disposal of drilling fluids may be carried out subject to the following conditions.

1. Permission of a Board representative shall be obtained before any disposal operation is commenced.

2. The disposal zone shall be at a depth not less than 600 metres.

3. The resistivity directly attributable to the total natural dissolved solids in the FORMATION WATER of the disposal zone shall be less than 0.33 OHM.M corrected to 20°C (equivalent to 20,000 ppm total dissolved solids).

4. The disposal zone shall be known not to contain hydrocarbons within two kilometres of the intended disposal well.

5. Where a well is to be abandoned or plugged back and does not contain at least 600 metres of casing cemented in place:

   a. the disposal of fluids shall be through drill pipe and below a seated packer, and

   b. the annulus between the drill pipe and the surface casing shall remain open to the atmosphere during any disposal operation.

6. Where a second casing string has been run in a well and not cemented to surface:

   a. the disposal of fluids shall be through the annulus between the casings, provided the surface casing is deeper than 600 metres,

b. the disposal zone shall be identified by depth and geological designation,

c. the fluids to be disposed shall be displaced out of the annulus with a corrosion inhibited fluid. If, after displacement, pressure exists in the annulus, cement shall be displaced into the formation to seal off the disposal interval, and

d. the annulus shall be left open to the atmosphere in the manner described in subsection 6.100(2) of The Oil and Gas Conservation Regulations.

7. Where the disposal zone has been cemented behind casing:

a. the disposal zone shall be identified by depth and geological designation,

b. the casing shall be perforated and the fluids disposed of through the perforations, and

c. the perforations shall be appropriately sealed or isolated.

ISSUED at Calgary, Alberta, on 12 March 1981.

ENERGY RESOURCES CONSERVATION BOARD

APPENDIX III

ENERGY AND NATURAL RESOURCES
INFORMATION LETTER 82-5

SUBJECT: Potassium-Based Drilling Mud Systems

In recent years some companies have chosen to use potassium-based drilling mud systems in special situations, particularly on the deeper wells being drilled in the Eastern Slopes Region of Alberta. The result has been large accumulation of fluids which represent a disposal problem because of their toxicity to aquatic life and to vegetation. No method currently exists to remove the potassium component.

Problems can be minimized if disposal is planned by the lessee prior to the commencement of drilling. An option that should receive special attention is contained in the Energy Resources Conservation Board's Interim Directive ID 81-1 of March 12, 1981, Subsurface Disposal of Drilling Fluids.

Commencing immediately, lessees of public lands who plan to use potassium-based drilling mud systems will be required to submit a plan for disposal of the fluids resulting from the drilling operation. Plan approval must be obtained from the field office of the Department designated in the surface lease conditions prior to the commencement of lease construction.

Further information may be obtained from the following persons:

Public Lands Inside the Green Area

Mr. W.N. Barnes
Forest Land Use Branch
Alberta Forest Service
Alberta Energy and Natural Resources
Bramalea Building
9920 - 108 Street
Edmonton, Alberta
T5K 2M4
Telephone: (403) 427-3587

Public Lands Outside the Green Area

Mr. D.G. Blackmore
Land Management and Development Branch
Public Lands Division
Alberta Energy and Natural Resources
Petroleum Plaza, South Tower
9915 - 108 Street
Edmonton, Alberta
T5K 2C9
Telephone: (403) 427-5209